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The growth, domain structures, electrical and magnetic properties of $BiFeO_3$-$PbTiO_3$ single crystals

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As one of the most popular single-phase multiferroics, the $BiFeO_3$ based materials attract lots of research interests due to the coexistence of ferroelectric and magnetic orderings above room temperature. Moreover, the extremely high electrostrain in excess of 1% is obtained in La-doped $BiFeO_3$-$PbTiO_3$ ceramics recently [1]. In this work, the single crystals of $BiFeO_3$-$PbTiO_3$ binary system have been successfully grown using molten-salt method [2]. The as-grown single crystals show dark color and cuboid shape with dimension up to 5 mm, as shown in Figure 1a. X-Ray Diffraction (XRD) results (see Fig. 1b) confirm the formation of pure perovskite structure with *P4mm* symmetry for the as-grown single crystals. The domain structures have been investigated by the Polarized Light Microscope and Piezoresponse Force Microscopy on the $(001)_{PC}$ polished single crystals. In addition, the saturated ferroelectric hysteresis loops are obtained. Finally, the magnetic properties and magnetic anisotropy have been studied by the Physical Property Measurement System and electron Spin resonance technology from room temperature down to 5 K. The results in this work based on BF-PT single crystals are helpful for further understanding of the ferroic couplings in the system.

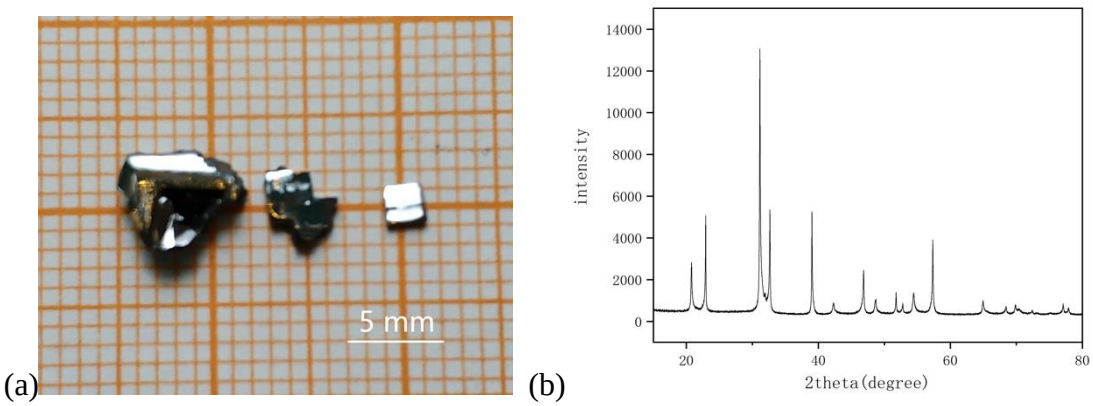

Figure 1. (a) The photographs and (b) the powder XRD pattern of as-grown $BiFeO_3$-$PbTiO_3$ single crystals.

1. B. Narayan, J. S. Malhotra, R. Pandey, et. al., *Nature Materials*, **17**, 427 (2018).
2. J. Zhuang, A. A. Bokov, N. Zhang, et. al., *Crystal Growth & Design*, **18**, 4503 (2018).